New Isotopes of Element 107: ^{266}Bh and ^{267}Bh*

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This experiment was undertaken to try to produce and identify the new neutron-rich isotopes of bohrium, ^{266}Bh and ^{267}Bh. These isotopes were predicted to have half-lives possibly long enough to enable studies of the chemical properties of Bh.

In our experiment, the nuclides ^{267}Bh and ^{266}Bh were produced via the ^{249}Bk(^{22}Ne,4*n*) and ^{249}Bk(^{22}Ne,5*n*) reactions. The LBNL 88-Inch Cyclotron provided 2-eμA beams of 148-MeV $^{22}Ne^{6+}$ and 153-MeV $^{22}Ne^{6+}$. The 0.81 mg/cm^2 ^{249}Bk target was prepared as the oxide by the molecular plating technique. Reaction products were transported from the target system [1] through a capillary to the merry-go-round (MG) detection system [2].

For this experiment, a parent-daughter stepping mode was used to provide detection of α-α correlations with a greatly reduced background [3].

A search was made for α-α correlations between Bh α-events ($8.6 < E_\alpha\,(MeV) < 10.5$) initiating parent-mode and subsequent daughter α-events ($8.2 < E_\alpha < 8.7$) detected in the same detector pair during the ensuing daughter mode search. Five atoms of ^{267}Bh ($T_{½} = 17^{+14}_{-6}$ s; E_α= 8.83±0.03 MeV) and one atom of ^{266}Bh (E_α = 9.29 MeV) were identified during the experiment. The five α-events attributed to the α-decay of ^{267}Bh daughter nuclei are consistent with ^{263}Lr and ^{259}Ha. The ^{249}Bk(^{22}Ne,4*n*)^{267}Bh cross section is about 70 pb.

Based the random correlation rate, we estimate that approximately one of the five ^{267}Bh α-α correlations reported is actually due to a random correlation of unrelated α decays. The expected number of random α-α-α triple correlations is 0.08.

During the entire experiment, there was only one instance where a potential parent event was followed by two α particles with $8.2 < E_\alpha(MeV) < 8.7$ in the daughter mode. The daughter-mode energies and lifetimes are consistent with those expected for ^{262}Ha and for ^{258}Lr. On this basis we assign this event to the decay of ^{266}Bh produced in the ^{249}Bk(^{22}Ne,5*n*) reaction. This triple correlation occurred during the 153-MeV bombardment, supporting the assignment of the 5*n*-exit channel.

The lifetime of the new isotope ^{267}Bh is sufficient for studies of the chemical properties of element 107 in either the aqueous or gas phase with fast separation techniques currently in use.

Footnotes and References

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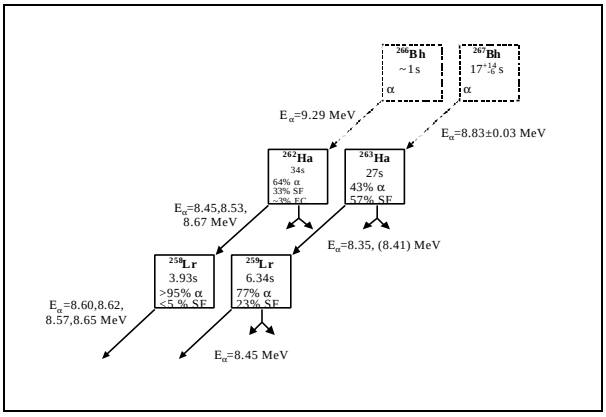

Fig. 1. Partial decay chain of ^{266}Bh and ^{267}Bh. Decay properties of ^{266}Bh and ^{267}Bh in the dashed boxes are as measured during this experiment.